T7 DLL User Guide

Version 2.1

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Amendments

Date	Comment(s)
08/08/2018	Removed CAN version. Removed GetMultiDropDelay and SetMultiDropDelay. Version 2.1
02/16/2011	The T7User.dll now supports Modbus protocol. Version 2.0
04/08/2009	Command response now includes address, length, and command. Version 1.1
3/27/2008	CAN Adapter Host Serial Communication User Guide. Version 1.0

1. Introduction

1.1 Purpose

This document describes how to install and use the T7 Demo software and T7 DLL on a PC running Windows. The T7 DLL provides a set of simple functions to access T7 inclinometers using either US Digital standard protocol or Modbus RTU over RS232 or RS485.

1.2 Scope

This document shall describe how to use each of the available interface methods provided by the T7. The following chapters are included.

- Installation Instructions
- Troubleshooting
- Getting Started
- Function Calls
- Constants
- Error Codes
- Enumerations

2 Software Installation Instructions

2.1 Installing Demo Software (Windows)

Download the T7 demo software from US Digital website http://www.usdigital.com/support/software/t7-software and run the T7 Demo Installation.

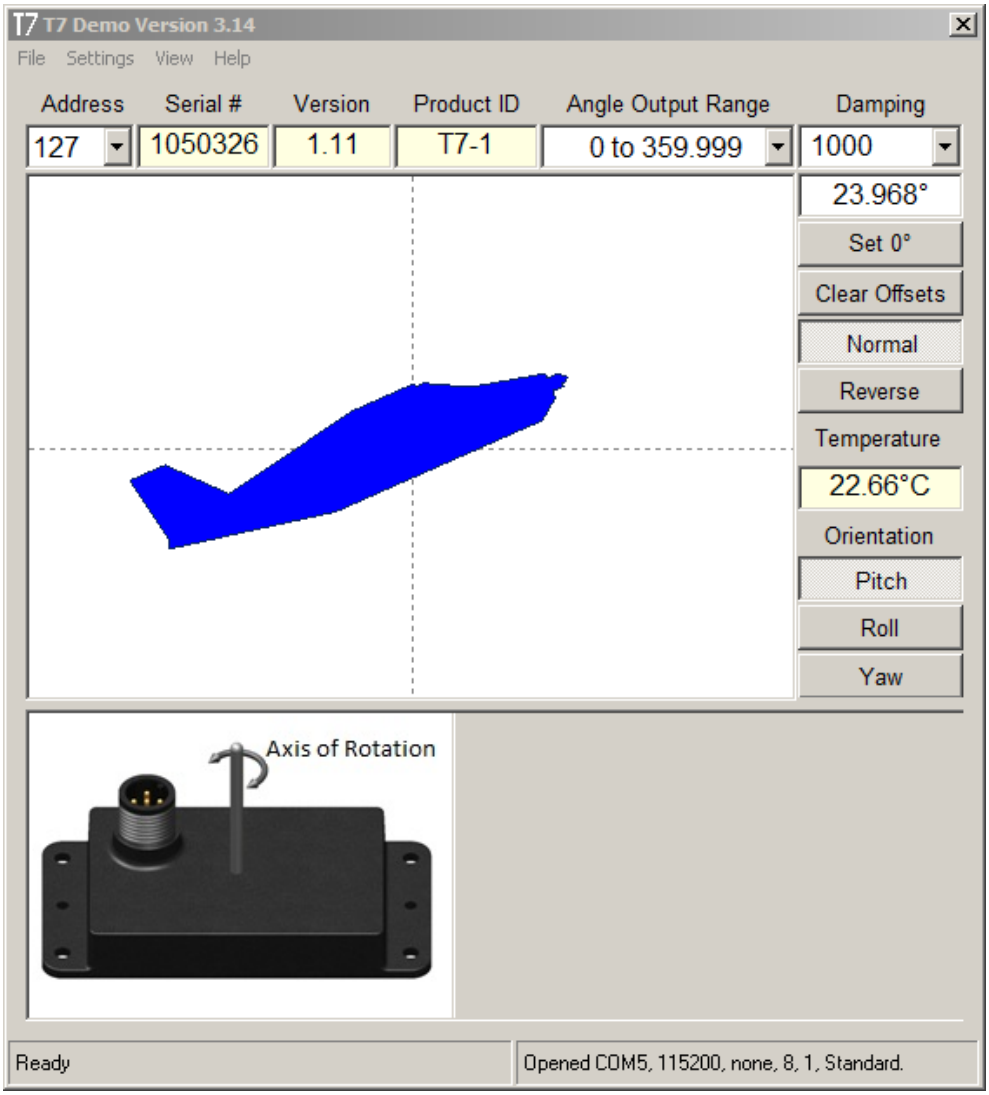
The installation program will install the T7 Demo and the appropriate libraries and drivers. One of the most common USB-to-serial drivers for FTDI IC based adapters is also installed.

3 Getting Started

3.1 Run Demo (T7 Demo)

After the T7 software package is installed and the T7 and host PC are connected together, the T7 Demo software may be run.

From the Start | Programs | US Digital | T7 menu, click on the T7Demo. The following demo application window will be displayed. Real time updates of the current angle and temperature of a selected T7 on the network are shown in the window. The T7 Demo also shows the current configuration settings of a T7 such as the damping time and offset. Changing a configuration setting will also automatically change the value in the T7's flash memory so that it will power up with the same settings.



The demo provides context sensitive tool-tip help information. Simply move the mouse cursor over a user input to display tool-tip information. The source code for the T7 Demo is included in the T7 software installation.

3.2 Hello-World Applications

This example shows how easy it is to start communicating with a T7 device by writing a few lines of code.

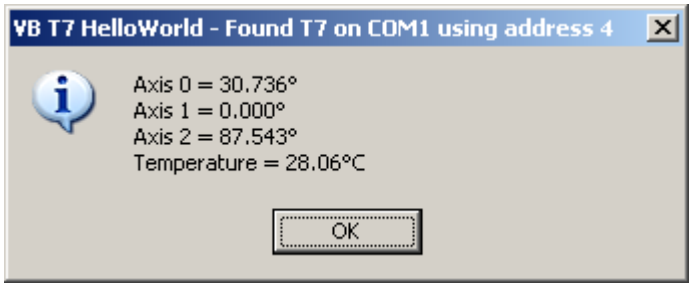
3.2.1 VB Example

1. Run Visual Basic 6.0 and create a new Standard EXE project.
2. Include the T7UserDeclarations.bas file in your project by Clicking on Project\Add Module. Click on the tab labeled Existing and then locate and open T7UserDeclarations.bas file.
3. Double click on the form to view the Form_Load subroutine and then paste the following code within the Form_Load sub:

```
Option Explicit

Private Sub Form_Load()
    Dim lResult         As Long
    Dim bytComPort      As Byte
    Dim bytAddress      As Byte
    Dim dblAngles(2)    As Double
    Dim dblTemperature  As Double

    ' Set the COM port number your device is attached to.
    bytComPort = 1

    ' Attempt to open the COM port.
    ' Run the T7ConfigUtility to determine which COM port you're using.
    lResult = T7_InitComm(bytComPort, e115200)

    ' Check if we're able to open the COM port.
    If T7_SUCCESS = lResult Then

        ' Identify the T7's address we want to talk too.
        bytAddress = GetAddressOfFirstDeviceFound(bytComPort)

        ' Get the angle of each axis.
        lResult = T7_GetAllAngles(bytComPort, bytAddress, dblAngles(0), dblAngles(1),
dblAngles(2), dblTemperature)
        If lResult = T7_SUCCESS Then
            MsgBox "Axis 0 = " & Format(dblAngles(0), "0.000") & Chr(176) & vbCrLf & _
                   "Axis 1 = " & Format(dblAngles(1), "0.000") & Chr(176) & vbCrLf & _
                   "Axis 2 = " & Format(dblAngles(2), "0.000") & Chr(176) & vbCrLf & _
                   "Temperature = " & Format(dblTemperature, "0.00") & Chr(176) & "C",
vbInformation, "VB T7 HelloWorld - Found T7 on COM" & bytComPort & " using address " &
bytAddress
        Else
            MsgBox "Error: " & GetT7ErrorDesc(lResult), vbExclamation, _
               "Failed to communicate with T7 on COM" & bytComPort & " using address " &
bytAddress
        End If
    Else
        MsgBox "Error: " & GetT7ErrorDesc(lResult), vbExclamation, _
               "Failed to communicate with T7 on COM" & bytComPort
    End If

    T7_CloseComm bytComPort
    Unload Me
End Sub

Private Function GetAddressOfFirstDeviceFound(bytComPort As Byte) As Byte
    Dim lResult                     As Long
    Dim bytCurrentAddress(0 To 63)  As Byte
```

```
    Dim bytDeviceType(0 To 63)      As Byte
    Dim ulSerial(0 To 63)           As Long
    Dim bytSize                     As Byte
    Dim i                           As Integer
    bytSize = 10

    lResult = T7_PingAddress(bytComPort, T7_BROADCAST_ADDRESS, bytCurrentAddress(0),
bytDeviceType(0), ulSerial(0), bytSize)
    If lResult = T7_SUCCESS Then
        If bytSize > 0 Then
            GetAddressOfFirstDeviceFound = bytCurrentAddress(0)
        End If
    End If
End Function
```

4. To run the application, press the F5 function key.
   A message box similar to the following will be displayed.



3.2.2 C Example

1. Run Microsoft Visual C++ and create a new Win32 Console Application by clicking on File New menu items.
2. Select the Projects Tab.
3. Click Win32 Console Application and enter T7HelloWorld for the Project name. Click OK.
4. Click on the option that says,"A Hello, World! Application." and then click the Finish button and the OK button on the New Project Information dialog that pops up.
5. Copy the T7User.h and T7User.lib files to the new project directory.
6. Click on Project Settings menu items. Click on the Link tab. Add T7User.lib to the end of Object/library modules field and then click OK.
7. Click on C/C++ tab. Select Precompiled Headers from the Category drop-down menu and then select Not using precompiled headers option.
8. Click on the FlieView tab within the Workspace frame. Expand the file folders and then double-click on T7HelloWorld.cpp node to open the file. Add the #include "..\Common\T7User.h" statement just above the main function.
9. Replace the code within the main function with a copy of the following code:

```
// C Hello World.cpp : Defines the entry point for the console application.
//

#include <conio.h>
#include "stdio.h"
#include "windows.h"
#include "..\Common\T7User.h"

int main()
{
        long lResult = 0;
    unsigned char ucCOMPort;
        unsigned char ucAddress = 0;
    double dblAngles[3] = {0,0,0};
        double dblTemperature = 0;

        printf("T7 HelloWorld\n");

    // Set the COM port number your device is attached to.
    ucCOMPort = 1;

        // Set the address of the T7 we want to talk to.
        ucAddress = 1;

    // Attempt to open the COM port.
    // Run the VB_T7_Demo to determine which COM port you're using.
    lResult = T7_InitComm(ucCOMPort, e115200);

    // Check if we're able to open the COM port.
    if(lResult == T7_SUCCESS)
        {
        // Get the angle of each axis.
        lResult = T7_GetAllAngles(ucCOMPort, ucAddress, &dblAngles[0], &dblAngles[1],
&dblAngles[2], &dblTemperature);
            printf("Axis 0 = %.3f\nAxis 1 = %.3f\nAxis 2 = %.3f\n", dblAngles[0], dblAngles[1],
dblAngles[2]);
    }

    if(lResult)
        {
        printf("Error: result = %d, Failed to communicate with T7 on COM%d\n", lResult,
ucCOMPort);
```

```
        }
        else
        {
         T7_CloseComm(ucCOMPort);
    }

        return 0;
}
```

10. Compile the code by pressing F7 function key and run the compiled code from a DOS window so that the output may be viewed.

4 Function Calls

For functions that need a device address, the valid range is typically 1-127. The default address for a T7 device is 127. All T7's listen to address 126.

4.1 T7_InitComm

Description:

The T7_InitComm function opens a specified COMM serial port for communication at a specified baud rate. Currently, the rate must be set to 115200 bits/sec.

Passed Parameters:

ucComPort

Specifies the COM port number to be opened. Valid range is from 1 to 255. COM port 255 is unique in that it may be used by T7_CloseComm to close all opened COM ports.

eBaudRateCode

Specifies the baud rate code

```
enum eBaudRateCode
{
   e115200 = 0,   // 115200 bits/sec
   e57600 = 1,
   e38400 = 2,
   e19200 = 3,
   e9600 = 4      // 9600 bits/sec
};
```

Returns:

Result code as 32-bit integer: See error code section for values other than zero. Zero implies the function call is successful.

C Declaration:

extern int __stdcall T7_InitComm(unsigned char *ucComPort,* enum *eBaudRateCode eCode*);

Example C Usage:

```
int iResult = 0;
unsigned char ucComPort = 1;
eBaudRateCode eCode = e115200;
iResult = T7_InitComm(ucComPort, eCode);
if (iResult != T7_SUCCESS) {
   // Handle error…
}
```

VB Declaration:

Public Declare Function T7_InitComm Lib "T7User.dll" (ByVal *bytComPort* As Byte, ByVal *eCode* As *eBaudRateCode*) As Long

Example VB Usage:

```
Dim bytComPort As Byte
Dim lResult As Long
Dim eCode As eBaudRateCode
bytComPort = 1    ' Use COM1...
eCode = e115200
lResult = T7_InitComm(bytComPort, eCode)
If lResult <> T7_SUCCESS Then
   ' Handle error...
End If
```

4.2 T7_SetBaudRate

Description:

The T7_SetBaudRate function sets the T7 to communicate at a different baud rate. Once the T7 has accepted the new baud rate, the opened COM is then updated to the new baud rate. The default baud rate is set to 115200 bits/sec.

Passed Parameters:

ucComPort

Specifies the COM port number to be accessed. Valid range is from 1 to 255.

ucAddress

Specifies the devices address.

eCode

Specifies the baud rate code.

```
enum eBaudRateCode
{
   e115200 = 0,  // 115200 bits/sec
   e57600 = 1,
   e38400 = 2,
   e19200 = 3,
   e9600 = 4      // 9600 bits/sec
};
```

Returns:

Result code as 32-bit integer: See error code section for values other than zero. Zero implies the function call is successful.

C Declaration:

extern int __stdcall T7_SetBaudRate(unsigned char *ucComPort*, unsigned char *ucAddress*, enum *eBaudRateCode eCode*);

Example C Usage:

```
int iResult = 0;
unsigned char ucComPort = 1;
unsigned char ucAddress = 0;
eBaudRateCode eCode = e115200;
iResult = T7_SetBaudRate(ucComPort, ucAddress, eCode);
if (iResult != 0) {
   // Handle error…
}
```

VB Declaration:

Public Declare Function T7_SetBaudRate Lib "T7User.dll" (ByVal *bytComPort* As Byte, ByVal *bytAddress* As Byte, ByVal *eCode* As *eBaudRateCode*) As Long

Example VB Usage:

```
Dim bytComPort As Byte
Dim bytAddress As Byte
Dim lResult As Long
Dim eCode As eBaudRateCode
eCode = e115200
bytComPort = 1    ' Access COM1...
bytAddress = 0
lResult = T7_SetBaudRate(bytComPort, bytAddress, eCode)
If lResult <> 0 Then
   ' Handle error...
End If
```

4.3 T7_CloseComm

Description:

The T7_CloseComm function closes a specified open COM port.

Passed Parameters:

ucComPort

Specifies the COM port number to be closed. Valid range is from 1 to 255. A value of 255 will cause all opened COM ports to close.

Returns:

Result code as 32-bit integer: See error code section for values other than zero. Zero implies the function call is successful.

C Declaration:

extern int __stdcall T7_CloseComm(unsigned char *ucComPort*);

Example C Usage:

```
int iResult = 0;
unsigned char ucComPort = 1;
iResult = T7_CloseComm(ucComPort);
if (iResult != 0) {
   // Handle error…
}
```

VB Declaration:

Public Declare Function T7_CloseComm Lib "T7User.dll" (ByVal *bytComPort* As Byte) As Long

Example VB Usage:

```
Dim bytComPort As Byte
Dim lResult As Long
bytComPort = 1    ' Close COM1...
lResult = T7_CloseComm(bytComPort)
If lResult <> T7_SUCCESS Then
   ' Handle error...
End If
```

4.4 T7_GetAllAngles

Description:

The T7_GetAllAngles function retrieves the angle (in degrees) for each axis.
See T7_GetAngleOutputRange to determine if the range of values returned are bidirectional (-180.000 to 179.999) or unidirectional (0.000 to 359.999).

Passed Parameters:

ucComPort
: Specifies the COM port number to be accessed. Valid range is from 1 to 255.

ucAddress
: Specifies the devices address. Valid range is from 1 to 127.

pdblAngle0
: Pointer to a double value which will receive angle for axis 0.

pdblAngle1
: Pointer to a double value which will receive angle for axis 1.

pdblAngle2
: Pointer to a double value which will receive angle for axis 2.

pdblTemperature
: Pointer to a double value which will receive the devices temperature in Celsius (-40.00 to 150.00).

Returns:

Result code as 32-bit integer: See error code section for values other than zero. Zero implies the function call is successful.

C Declaration:

extern int __stdcall T7_GetAllAngles(unsigned char *ucComPort*, unsigned char *ucAddress*, double * *pdblAngle0,* double * *pdblAngle1,* double * *pdblAngle2,* double * *pdblTemperautre*);

Example C Usage:

```
int iResult = 0;
unsigned char ucComPort = 1;
unsigned char ucAddress = 1;
double dblAngles[3] = {0,0,0};
double dblTemperature = 0;
iResult = T7_GetAllAngles(ucComPort, ucAddress, &dblAngles[0], &dblAngles[1], &dblAngles[2],
&dblTemperature);
if (iResult != T7_SUCCESS) {
   // Handle error…
}
```

VB Declaration:

Public Declare Function T7_GetAllAngles Lib "T7User.dll" (ByVal *bytComPort* As Byte, ByVal *bytAddress* As Byte, ByRef *dblAngle0* As Double, ByRef *dblAngle1* As Double, ByRef *dblAngle2* As Double, ByRef *dblTemperature* As Double) As Long

Example VB Usage:

```
Dim bytComPort As Byte
Dim bytAddress As Byte
Dim lResult As Long
Dim dblAngle0 As Double
Dim dblAngle1 As Double
Dim dblAngle2 As Double
Dim dblTemp As Double

bytComPort = 1    ' Access COM1...
bytAddress = 1
lResult = T7_GetAllAngles(bytComPort, bytAddress, dblAngle0, dblAngle1, dblAngle2, dblTemp)
If lResult <> T7_SUCCESS Then
   ' Handle error...
End If
```

4.5 T7_GetAngle

Description:

The T7_GetAngle function gets one angle (in degrees) for a specified axis.
See T7_GetAngleOutputRange to determine if the range of values returned are bidirectional (-180.000 to 179.999) or unidirectional (0.000 to 359.999).

Passed Parameters:

ucComPort
: Specifies the COM port number to be accessed. Valid range is from 1 to 255.

ucAddress
: Specifies the devices address. Valid range is from 1 to 127.

eAxis
: Specifies the axis of whose angle should be returned. Valid range is from 0 to 2.

pdblAngle
: Pointer to a double value which will receive the angle for the specified axis.

Returns:
Result code as 32-bit integer: See error code section for values other than zero. Zero implies the function call is successful.

C Declaration:
extern int __stdcall T7_GetAngle(unsigned char *ucComPort*, unsigned char *ucAddress*, enum eAxis *axis*, double * *pdblAngle*);

Example C Usage:
```
int iResult = 0;
unsigned char ucComPort = 1;
unsigned char ucAddress = 1;
double dblAngle = 0;
iResult = T7_GetAngle(ucComPort, ucAddress, eZAxis, &dblAngle);
if (iResult != T7_SUCCESS) {
   // Handle error…
}
```

VB Declaration:
Public Declare Function T7_GetAngle Lib "T7User.dll" (ByVal *bytComPort* As Byte, ByVal *bytAddress* As Byte, ByVal *axis* As *eAxis*, ByRef *dblAngle* As Double) As Long

Example VB Usage:
```
Dim bytComPort As Byte
Dim bytAddress As Byte
Dim lResult As Long
Dim dblAngle As Double
bytComPort = 1
bytAddress = 1
dblAngle = 0
lResult = T7_GetAngle(bytComPort, bytAddress, eZAxis, dblAngle)
If lResult <> T7_SUCCESS Then
   ' Handle error...
End If
```

4.6 T7_SetAngle

Description:
The T7_SetAngle function calculates and sets the internally stored angle offset value so that the currently reported angle equals the angle parameter value specified. The angle offset value is added to the angle reported by the sensor.

Passed Parameters:
ucComPort
Specifies the COM port number to be accessed. Valid range is from 1 to 255.
ucAddress
Specifies the devices address. Valid range is from 1 to 127.
eAxis

Specifies the axis of whose angle should be returned. Valid range is from 0 to 2.

pdblAngle

Specifies the angle that should be reported for the specified axis at the current orientation. Valid range is from -180.00 to 179.999 or 0 to 359.999 degrees depending on the selected angle output range.

Returns:

Result code as 32-bit integer: See error code section for values other than zero. Zero implies the function call is successful.

C Declaration:

extern int __stdcall T7_SetAngle(unsigned char *ucComPort*, unsigned char *ucAddress*, enum eAxis *axis*, double *dblAngle*);

Example C Usage:

```
int iResult = 0;
unsigned char ucComPort = 1;
unsigned char ucAddress = 1;
double dblAngle = 45.5;
iResult = T7_SetAngle(ucComPort, ucAddress, eZAxis, dblAngle);
if (iResult != T7_SUCCESS) {
   // Handle error…
}
```

VB Declaration:

Public Declare Function T7_SetAngle Lib "T7User.dll" (ByVal *bytComPort* As Byte, ByVal *bytAddress* As Byte, ByVal *axis* As *eAxis*, ByVal *dblAngle* As Double) As Long

Example VB Usage:

```
Dim bytComPort As Byte
Dim bytAddress As Byte
Dim lResult As Long
Dim dblAngle As Double
bytComPort = 1
bytAddress = 1
dblAngle = 45.5
lResult = T7_SetAngle(bytComPort, bytAddress, eZAxis, dblAngle)
If lResult <> T7_SUCCESS Then
   ' Handle error...
End If
```

4.7 T7_GetAllAngleOffsets

Description:

The T7_GetAngleOffset function retrieves the angle offsets (in degrees) for all axes.

Passed Parameters:

ucComPort

Specifies the COM port number to be accessed. Valid range is from 1 to 255.

ucAddress

Specifies the devices address. Valid range is from 1 to 127.

pdblAngle0

Pointer to a double value which will receive angle offset for axis 0.

pdblAngle1

Pointer to a double value which will receive angle offset for axis 1.

pdblAngle2

Pointer to a double value which will receive angle offset for axis 2.

Returns:

Result code as 32-bit integer: See error code section for values other than zero. Zero implies the function call is successful.

C Declaration:

extern int __stdcall T7_GetAngleOffset(unsigned char *ucComPort*, unsigned char *ucAddress*, double * *pdblOffset0,* double * *pdblOffset1,* double * *pdblOffset2*);

Example C Usage:

```
int iResult = 0;
unsigned char ucComPort = 1;
unsigned char ucAddress = 1;
double dblOffsets[3] = {0,0,0};
iResult = T7_GetAllAngleOffsets(ucComPort, ucAddress, &dblOffsets[0] , &dblOffsets[1] , &dblOffsets[2]);
if (iResult != T7_SUCCESS) {    // Handle error…}
```

VB Declaration:

Public Declare Function T7_GetAllAngleOffsets Lib "T7User.dll" (ByVal *bytComPort* As Byte, ByVal *bytAddress* As Byte, ByRef *dblOffset0* As Double, ByRef *dblOffset1* As Double, ByRef *dblOffset2* As Double) As Long

Example VB Usage:

```
Dim bytComPort As Byte
Dim bytAddress As Byte
Dim lResult As Long
Dim dblOffsets(0 To 2) As Double
bytComPort = 1    ' Access COM1...
bytAddress = 1
lResult = T7_GetAllAngleOffsets(bytComPort, bytAddress, dblOffsets(0), dblOffsets(1), dblOffsets(2))
If lResult <> T7_SUCCESS Then
   ' Handle error...
```

End If

4.8 T7_SetAngleOffset

Description:

The T7_SetAngleOffset function sets the angle offset (in degrees) for a specified axis.

Passed Parameters:

ucComPort
Specifies the COM port number to be accessed. Valid range is from 1 to 255.
ucAddress
Specifies the devices address. Valid range is from 1 to 127.
eAxis
Specifies the axis of whose angle should be set. Valid range is from 0 to 2.
dblOffset
Specifies the new angle offset.

Returns:

Result code as 32-bit integer: See error code section for values other than zero. Zero implies the function call is successful.

C Declaration:

extern int __stdcall T7_SetAngleOffset(unsigned char *ucComPort*, unsigned char *ucAddress*, enum *eAxis axis*, double *dblOffset*);

Example C Usage:

```
int iResult = 0;
unsigned char ucComPort = 1;
unsigned char ucAddress = 1;
double dblOffset = 90.0;
iResult = T7_SetAngleOffset(ucComPort, ucAddress, eZAxis, dblOffset);
if (iResult != T7_SUCCESS) {
   // Handle error…
}
```

VB Declaration:

Public Declare Function T7_SetAngleOffset Lib "T7User.dll" (ByVal *bytComPort* As Byte, ByVal *bytAddress* As Byte, ByVal *axis* As *eAxis*, ByVal *dblOffset* As Double) As Long

Example VB Usage:

```
Dim bytComPort As Byte
Dim bytAddress As Byte
Dim lResult As Long
Dim dblOffset As Double
bytComPort = 1
bytAddress = 1
dblOffset = 90.0
lResult = T7_SetAngleOffset(bytComPort, bytAddress, eZAxis, dblOffset)
If lResult <> T7_SUCCESS Then
   ' Handle error...
```

End If

4.9 T7_GetAllData

Description:

The T7_GetAllData function retrieves the angle (in degrees) for each axis, device temperature, damped acceleration outputs for each axis, and the device's serial number.

See T7_GetAngeOutputRange to determine if the range of values returned are (-180.000 to 179.999) or (0 to 359.999).

Passed Parameters:

ucComPort
Specifies the COM port number to be accessed. Valid range is from 1 to 255.
ucAddress
Specifies the devices address. Valid range is from 1 to 127.
pdblAngle0
Pointer to a double value which will receive angle for axis 0.
pdblAngle1
Pointer to a double value which will receive angle for axis 1.
pdblAngle2
Pointer to a double value which will receive angle for axis 2.
pdblTemperature
Pointer to a double value which will receive the devices temperature in Celsius (-40.00 to 150.00).
pdblAccel0
Pointer to a double value which will receive acceleration for axis 0.
pdblAccel1
Pointer to a double value which will receive acceleration for axis 1.
pdblAccel2
Pointer to a double value which will receive acceleration for axis 2.
plSerialNo
Pointer to an unsigned long value which will receive the device's serial number.

Returns:

Result code as 32-bit integer: See error code section for values other than zero. Zero implies the function call is successful.

C Declaration:

extern int __stdcall T7_GetAllData(unsigned char *ucComPort*, unsigned char *ucAddress*, double * *pdblAngle0,* double * *pdblAngle1,* double * *pdblAngle2*, double * *pdblTemperature*, double * *pdblAccel0*, double * *pdblAccel1*, double * *pdblAccel2*, unsigned long * *pulSerialNo*);

Example C Usage:

```
int iResult = 0;
unsigned char ucComPort = 1;
unsigned char ucAddress = 1;
double dblAngle[3] = {0,0,0};
double dblTemperature = 0.0;
double dblAccel[3] = {0,0,0};
unsigned long ulSerialNo = 0;

iResult = T7_ReadAllData(ucComPort, ucAddress, &dblAngle[0] , &dblAngle[1] , &dblAngle[2],
&dblTemperature, &dblAccel[0], &dblAccel[1], &dblAccel[2], &ulSerialNo);
if (iResult != T7_SUCCESS) { // Handle error…}
```

VB Declaration:

Public Declare Function T7_GetAllData Lib "T7User.dll" (ByVal *bytComPort* As Byte, ByVal *bytAddress* As Byte, ByRef *dblAngle0* As Double, ByRef *dblAngle1* As Double, ByRef *dblAngle2* As Double, ByRef *dblTemperature* As Double, ByRef *dblAccel0* As Double, ByRef *dblAccel1* As Double, ByRef *dblAccel2* As Double, ByRef *lSerialNo As Long*) As Long

Example VB Usage:

```
Dim bytComPort As Byte
Dim bytAddress As Byte
Dim lResult As Long
Dim dblAngles(0 To 2) As Double
Dim dblTemperature As Double
Dim dblAccels(0 To 2) As Double
Dim lSerialNo As Long
bytComPort = 1 ' Access COM1...
bytAddress = 1

lResult = T7_GetAllData(bytComPort, bytAddress, dblAngles(0), dblAngles(1), dblAngles(2),
dlbTemperature, dblAccels(0), dblAccels(1), dblAccels(2), lSerialNo)
If lResult <> T7_SUCCESS Then
' Handle error...
End If
```

4.10 T7_GetAllDirections

Description:

The T7_GetAllDirections function retrieves the angle increase direction of each axis (normal or reversed).

Passed Parameters:

ucComPort

Specifies the COM port number to be accessed. Valid range is from 1 to 255.

ucAddress

Specifies the devices address. Valid range is from 1 to 127.

pucDirections0

Pointer to axis 0 angle increase direction byte. 0 = normal, 1 = reversed.

pucDirections1

Pointer to axis 1 angle increase direction byte. 0 = normal, 1 = reversed.

pucDirections2

Pointer to axis 2 angle increase direction byte. 0 = normal, 1 = reversed.

Returns:

Result code as 32-bit integer: See error code section for values other than zero. Zero implies the function call is successful.

C Declaration:

extern int __stdcall T7_GetAllDirections(unsigned char *ucComPort*, unsigned char *ucAddress*, unsigned char * *pucDirection0,* unsigned char * *pucDirection1,* unsigned char * *pcDirection2*);

Example C Usage:

```
int iResult = 0;
unsigned char ucComPort = 1;
unsigned char ucAddress = 1;
unsigned char cDirections[3] = {0,0,0};
iResult = T7_GetAllDirections(ucComPort, ucAddress, &ucDirections[0], &ucDirections[1],
&ucDirections[2]);
if (iResult != T7_SUCCESS) {
   // Handle error…
}
```

VB Declaration:

Public Declare Function T7_GetAllDirections Lib "T7User.dll" (ByVal *bytComPort* As Byte, ByVal *bytAddress* As Byte, ByRef *bytDirection0* As Byte, ByRef *bytDirection1* As Byte, ByRef *bytDirection2* As Byte) As Long

Example VB Usage:

```
Dim bytComPort As Byte
Dim bytAddress As Byte
Dim lResult As Long
Dim bytDirecitons(0 To 2) As Byte
bytComPort = 1    ' Access COM1...
bytAddress = 1
lResult = T7_GetAllDirections(bytComPort, bytAddress, bytDirecitons(0), bytDirecitons(1),
bytDirecitons(2))
If lResult <> T7_SUCCESS Then
   ' Handle error...
End If
```

4.11 T7_SetDirection

Description:

The T7_SetDirection function sets the angle increase direction for a specified axis (normal or reversed).

Passed Parameters:

ucComPort

Specifies the COM port number to be accessed. Valid range is from 1 to 255.

ucAddress

Specifies the devices address. Valid range is from 1 to 127.

eAxis

Specifies the axis whose angle increase direction is set. Valid range is from 0 to 2.

```
enum eAxis {
        eXAxis = 0,
        ePitch = 0,
        eYAxis = 1,
        eRoll = 1,
        eZAxis = 2,
        eYaw = 2
};
```

ucDirection

The angle increase direction byte. 0 = normal, 1 = reversed.

Returns:

Result code as 32-bit integer: See error code section for values other than zero. Zero implies the function call is successful.

C Declaration:

extern int __stdcall T7_SetDirection(unsigned char *ucComPort*, unsigned char *ucAddress*, enum *eAxis axis*, unsigned char u*cDirection*);

Example C Usage:

```
int iResult = 0;
unsigned char ucComPort = 1;
unsigned char ucAddress = 1;
unsigned char ucDirection = 1;
iResult = T7_SetDirection(ucComPort, ucAddress, eZAxis, ucDirection);
if (iResult != 0) {
   // Handle error…
}
```

VB Declaration:

Public Declare Function T7_SetDirection Lib "T7User.dll" (ByVal *bytComPort* As Byte, ByVal *bytAddress* As Byte, ByVal *axis* As eAxis, ByVal *bytDirection* As Byte) As Long

Example VB Usage:

```
Dim bytComPort As Byte
Dim bytAddress As Byte
Dim lResult As Long
Dim bytDirection As Byte
bytComPort = 1
bytAddress = 1
bytDirection = 1
lResult = T7_SetDirection (bytComPort, bytAddress, eZAxis, bytDirection)
If lResult <> 0 Then
   ' Handle error...
End If
```

4.12 T7_GetDamping

Description:

Requests the damping time in milliseconds.

Electronic damping is achieved by averaging multiple angle readings together to reduce noise. As the damping time is increased, the angle readings are smoother and lower in noise, but the response time is slower. The number of samples averaged per reported position can be calculated by multiplying the damping time in seconds by 640.

Example: When the damping is set to 125 milliseconds, each reported position will be the average of the previous 80 samples; 250 milliseconds will be the average of the previous 160 samples. To most closely match the damping of the T7 to US Digital's A2T optical encoder inclinometer, specify 125 milliseconds for standard damping and 250 milliseconds for double damping.

Passed Parameters:

ucComPort

Specifies the COM port number to be accessed. Valid range is from 1 to 255.

ucAddress

Specifies the devices address. Valid range is from 1 to 127.

puiTime

Pointer to integer that will hold the damping time in milliseconds. Valid range is from 2 to 5,000 with values 0 and 1 being reserved.

Returns:

Result code as 32-bit integer: See error code section for values other than zero. Zero implies the function call is successful.

C Declaration:

extern int __stdcall T7_GetDamping(unsigned char *ucComPort*, unsigned char *ucAddress,* unsigned short * *puiTime*);

Example C Usage:

```
int iResult = 0;
unsigned char ucComPort = 1;
unsigned char ucAddress = 1;
unsigned short uiTime = 0;
iResult = T7_GetDamping(ucComPort, ucAddress, &uiTime);
if (iResult != 0) {    // Handle error… }
```

VB Declaration:

Public Declare Function T7_GetDamping Lib "T7User.dll" (ByVal *bytComPort* As Byte, ByVal *bytAddress* As Byte, ByRef i*Time* As Integer) As Long

Example VB Usage:

```
Dim bytComPort As Byte
Dim bytAddress As Byte
Dim lResult As Long
Dim iTime As Integer
bytAddress = 1
bytComPort = 1    ' Access COM1...
lResult = T7_GetDamping(bytComPort, bytAddress, iTime)
If lResult <> 0 Then
   ' Handle error...
End If
```

4.13 T7_SetDamping

Description:

Set the damping time in milliseconds.
Refer to T7_GetDamping for an expanded description.

Passed Parameters:

ucComPort

Specifies the COM port number to be accessed. Valid range is from 1 to 255.

ucAddress

Specifies the devices address. Valid range is from 1 to 127.

uiTime

The new damping time value. Valid range is from 2 (2 milliseconds) to 5,000 (5 seconds) with values 0 and 1 being reserved.

Returns:

Result code as 32-bit integer: See error code section for values other than zero. Zero implies the function call is successful.

C Declaration:

extern int __stdcall T7_SetDamping(unsigned char *ucComPort*, unsigned char *ucAddress,* unsigned short *uiTime*);

Example C Usage:

```
int iResult = 0;
unsigned char ucComPort = 1;
unsigned char ucAddress = 1;
unsigned short uiTime = 500;
iResult = T7_SetDamping(ucComPort, ucAddress, uiTime);
if (iResult != 0) {
   // Handle error…
}
```

VB Declaration:

Public Declare Function T7_SetDamping Lib "T7User.dll" (ByVal *bytComPort* As Byte, ByVal *bytAddress* As Byte, ByVal iTime As Integer) As Long

Example VB Usage:

```
Dim bytComPort As Byte
Dim bytAddress As Byte
Dim lResult As Long
Dim iTime As Integer
bytComPort = 1    ' Access COM1...
bytAddress = 1
lTime = 500
lResult = T7_SetDamping(bytComPort, bytAddress, iTime)
If lResult <> 0 Then
   ' Handle error...
End If
```

4.14 T7_GetAngleOutputRange

Description:

The T7_GetAngleOutputRange function retrieves a single byte that indicates the angle output range for all three axes.

Passed Parameters:

ucComPort

Specifies the COM port number to be accessed. Valid range is from 1 to 255.

ucAddress

Specifies the devices address. Valid range is from 1 to 127.

pucAngleOutputRange

Pointer to the angle output range byte.
0 = bidirectional (-180.000° to 179.999°)
1 = unidirectional (0.000° to 359.999°)

Returns:

Result code as 32-bit integer: See error code section for values other than zero. Zero implies the function call is successful.

C Declaration:

extern int __stdcall T7_GetAngleOutputRange(unsigned char *ucComPort*, unsigned char *ucAddress*, unsigned char * *pucAngleOutputRange*);

Example C Usage:

```
int iResult = 0;
unsigned char ucComPort = 1;
unsigned char ucAddress = 1;
unsigned char ucAngleOutputRange = 0;
iResult = T7_GetAngleOutputRange(ucComPort, ucAddress, &ucAngleOutputRange);
if (iResult != 0) {
   // Handle error…
}
```

VB Declaration:

Public Declare Function T7_GetAngleOutputRange Lib "T7User.dll" (ByVal *bytComPort* As Byte, ByVal *bytAddress* As Byte, ByRef byt*AngleOutputRange* As Byte) As Long

Example VB Usage:

```
Dim bytComPort As Byte
Dim bytAddress As Byte
Dim lResult As Long
Dim bytAngleOutputRange As Byte
bytComPort = 1    ' Access COM1...
bytAddress = 1
lResult = T7_GetAngleOutputRange(bytComPort, bytAddress, bytAngleOutputRange)
If lResult <> 0 Then
   ' Handle error...
End If
```

4.15 T7_SetAngleOutputRange

Description:

The T7_SetAngleOutputRange function is used to set the angle output range for all three axes to bidirectional (-180.000° to 179.999°) or unidirectional (0.000° to 359.999°)

Passed Parameters:

ucComPort
Specifies the COM port number to be accessed. Valid range is from 1 to 255.
ucAddress
Specifies the devices address. Valid range is from 1 to 127.
ucAngleOutputRange
0 = bidirectional (-180.000° to 179.999°)
1 = unidirectional (0.000° to 359.999°)

Returns:
Result code as 32-bit integer: See error code section for values other than zero. Zero implies the function call is successful.

C Declaration:
extern int __stdcall T7_SetAngleOutputRange(unsigned char *ucComPort*, unsigned char *ucAddress*, unsigned char u*cAngleOutputRange*);

Example C Usage:
```
int iResult = 0;
unsigned char ucComPort = 1;
unsigned char ucAddress = 1;
unsigned char ucAngleOutputRange = 1;
iResult = T7_SetAngleOutputRange(ucComPort, ucAddress, ucAngleOutputRange);
if (iResult != 0) {
   // Handle error…
}
```

VB Declaration:
Public Declare Function T7_SetAngleOutputRange Lib "T7User.dll" (ByVal *bytComPort* As Byte, ByVal *bytAddress* As Byte, ByVal *bytAngleOutputRange* As Byte) As Long

Example VB Usage:
```
Dim bytComPort As Byte
Dim bytAddress As Byte
Dim lResult As Long
Dim bytAngleOutputRange As Byte
bytAngleOutputRange = 1
bytComPort = 1    ' Access COM1...
bytAddress = 1
lResult = T7_SetAngleOutputRange(bytComPort, bytAddress, bytAngleOutputRange)
If lResult <> 0 Then
   ' Handle error...
End If
```

4.16 T7_GetDeviceInfo

Description:
The T7_GetDeviceInfo function gets the following factory settings from the T7: serial number, firmware revision, product type and calibration status.

Passed Parameters:

ucComPort

Specifies the COM port number to be accessed. Valid range is from 1 to 255.

ucAddress

Specifies the devices address. Valid range is from 1 to 127.

pulSerialNo

Pointer to a long value that will hold the returned serial number.

puiFirmware

Pointer to a 6 byte array of characters that will hold the returned firmware version. Padded with spaces and not null terminated.

puiProduct

Pointer to a 6 byte array of characters that will hold the returned product type. Padded with spaces and not null terminated.

puiCalibrationStatus

Pointer to an unsigned integer describing the calibration status:

Bit	Description
0	set if axis 0 is calibrated
1	set if axis 1 is calibrated
2	set if axis 2 is calibrated
3	set if calibration is temperature compensated
4-15	reserved

Returns:

Result code as 32-bit integer: See error code section for values other than zero. Zero implies the function call is successful.

C Declaration:

extern int __stdcall T7_GetDeviceInfo(unsigned char *ucComPort*, unsigned char *ucAddress*, unsigned long * *pulSerialNo*, unsigned char * *pucFirmware*, unsigned char * *pucProduct*, unsigned short * *puiCalibrationStatus*);

Example C Usage:

```
int iResult = 0;
unsigned char ucComPort = 1;
unsigned long ulSerialNo = 0;
unsigned char ucAddress = 1;
unsigned char ucFirmware[6];
unsigned char ucProduct[6];
unsigned short uiCalibrationStatus = 0;
iResult = T7_GetDeviceInfo(ucComPort, ucAddress, &ulSerialNo, &ucFirmware, &ucProduct,
&uiCalibrationStatus);
if (iResult != 0) {
   // Handle error…
}
```

VB Declaration:

Public Declare Function T7_GetDeviceInfo Lib "T7User.dll" (ByVal *bytComPort* As Byte, ByVal *bytAddress* As Byte, ByRef *lSerialNo As Long*, ByRef byt*Firmware* As Byte, ByRef byt*Product* As Byte, ByRef *iCalibrationStatus* As Integer) As Long

Example VB Usage:

```
Dim bytComPort As Byte
Dim bytAddress As Byte

Dim lResult As Long
Dim lSeriaNo As Long
Dim bytFirmware(0 To 5) As Byte
Dim bytProduct(0 To 5) As Byte
Dim iCalibrationStatus As Integer
bytComPort = 1    ' Access COM1...
bytAddress = 1
lResult = T7_GetDeviceInfo(bytComPort, bytAddress, lSerialNo, bytFirmware, bytProduct,
iCalibrationStatus)
If lResult <> 0 Then
   ' Handle error...
End If
```

4.17 T7_SetAddress

Description:

The T7_SetAddress function changes the address of a T7.

Passed Parameters:

ucComPort

Specifies the COM port number to be accessed.

ucAddress

Specifies the devices address. Valid range is 1 to 127. The default address for a T7 device is 127. All T7's listen to address 126.

ucDeviceType

An unsigned char that identifies the device type. The device type for a T7-3 is 1 and T7-1 is 4.

ulSerialNo

Unsigned long value that matches the T7 device's serial number whose address is to be changed.

ucNewAddress

The new address that will be written to the T7 device.

Returns:

Result code as 32-bit integer: See error code section for values other than zero. Zero implies the function call is successful.

C Declaration:

extern int __stdcall T7_ SetAddress (unsigned char *ucComPort*, unsigned char *ucAddress*, unsigned char *ucDeviceType*, unsigned long *ulSerialNo*, unsigned char *ucNewAddress*);

Example C Usage:

```
int iResult = 0;
unsigned char ucCOMPort = 1;
```

```
unsigned char ucAddress = 127;
unsigned char ucDeviceType = 1;
unsigned long ulSerialNo = 12345;
unsigned char ucNewAddress = 1;
 iResult = T7_SetAddress(ucComPort, ucAddress, ucDeviceType, ulSerialNo, ucNewAddress);
if (iResult != 0) {
   // Handle error…
}
```

VB Declaration:

Public Declare Function T7_SetAddress Lib "T7User.dll" (ByVal *bytComPort* As Byte, ByVal *bytAddress* As Byte, ByVal *bytDeviceType* As Byte, ByVal *lSerialNo* As Long, ByVal *bytNewAddress* As Byte) As Long

Example VB Usage:

```
Dim lResult As Long
Dim bytComPort As Byte
Dim bytAddress As Byte
Dim bytDeviceType As Byte
Dim lSeriaNo As Long
Dim bytSize As Byte

bytComPort = 1    ' Access COM1...
bytAddress = 1
ulSeriaNo = 12345
bytNewAddress = 1
lResult = T7_SetAddress(bytComPort, bytAddress, bytDeviceType, lSerialNo, bytNewAddress)
If lResult <> 0 Then
   ' Handle error...
End If
```

5 Constants

```
#define T7_MAX_COMM_PORTS          255    // Maximum number of COM ports
#define T7_MAX_DEVICES_PER_PORT    64     // Maximum number of device per COM
                                          // port
#define T7_MAX_BAUD_RATE           115200 // Maximum baud rate
                                          // Supported baud rates: 9600, 19200,
                                          // 38400, 57600, 115200
#define T7_MIN_DAMPING_CODE        2      // Minimum damping time (millisecond)
#define T7_MAX_DAMPING_CODE        5000   // Maximum damping time (millisecond)
#define T7_BROADCAST_ADDRESS       126    // broadcast address that all devices
                                          // listen to
```

6 Error Codes

```
#define T7_SUCCESS                 0x00   // Success.
#define T7_INVALID_COMMAND         0x01   // Invalid command.
#define T7_RESERVED_1              0x02   // Reserved
#define T7_INVALID_PARAMETER       0x03   // Invalid Parameter.
#define T7_CHECKSUM_ERROR_TX       0x04   // Checksum error sent to the T7.
#define T7_COMMAND_FAILED          0x05   // Command failed.
#define T7_RESERVED_2              0x06   // Reserved
#define T7_FLASH_ERASE_ERROR       0x07   // Flash erase error from T7.
#define T7_FLASH_PROGRAM_ERROR     0x08   // Flash program error from T7.
#define T7_ADDRESS_OUT_OF_RANGE    0x09   // Address out of Range

#define T7_INVALID_COMPORT         0x80   // Invalid com port specified.
#define T7_FAIL_TO_OPEN_COM_PORT   0x81   // Failed to com port.
#define T7_COMM_ERROR              0x82   // Generic com error.
#define T7_COM_PORT_NOT_OPEN       0x83   // Com port not open.
#define T7_FAILED_TO_SET_COM_PORT_TIMEOUT 0x84 // Failed to set com port timeout.
#define T7_FAILED_TO_FLUSH_COM_PORT 0x85  // Failed to purge the com port.
#define T7_FAILED_TO_CLEAR_COM_ERROR 0x86 // Failed to clear com port error.
#define T7_INVALID_AXIS            0x87   // Invalid axis specified.
#define T7_COMM_TIMEOUT            0x88   // Failed to receive expected data.
#define T7_CHECKSUM_ERROR_RX       0x89   // Checksum error sent from the T7.
```

7 Enumerations

C Declaration	VB Declaration

enum eTemperatureRange
{
eLow = 0,
eMid = 1,
eHigh = 2
};
	Public Enum eAxis
	eXAxis = 0
	ePitch = 0
	eYAxis = 1
	eRoll = 1
	eZAxis = 2
	eYaw = 2
	End Enum

enum eTemperatureRange
{
eLow = 0,
eMid = 1,
eHigh = 2
};
	Enum eTemperatureRange
	eLow = 0
	eMid = 1
	eHigh = 2
	End Enum

enum eBaudRateCode
{
e115200 = 0,
e57600 = 1,
e38400 = 2,
e19200 = 3,
e9600 = 4
};
	Enum eBaudRateCode
	e115200 = 0
	e57600 = 1
	e38400 = 2
	e19200 = 3
	e9600 = 4
	End Enum